Chapter 26

Applying Science to Sub-Saharan Africa's Food Needs

Reported by Ellen Wilson

In the drive to develop the best technology to solve Sub-Saharan Africa's mounting food needs, indigenous knowledge should not be forgotten.

With biotechnology and other new agricultural technology on the horizon, millions of Sub-Saharan Africans have reason to wonder whether there will be a magic bullet that will save their countries from massive food shortages. The answer, as given by African leaders and researchers and other global agriculture experts, seems to be "no, there will not be a magic bullet." But biotechnology should be in the mix of solutions to food insecurity in Sub-Saharan Africa. And equally, if not more important, are food policy changes and new technology that focus on a range of issues from increasing cassava crop yields to more-effective ways to capture and store water during the rainy season.

"Africans cannot afford to be left behind in the area of biotechnology," said Professor Francis Idachaba, vice-chancellor of the University of Agriculture in Makurdi, Nigeria. "African farmers must be prepared for advances in biotechnology so that they can replace their seeds with genetically engineered seeds. However, there are many other policy problems that need to be addressed first. Food insecurity is not due to the fact that we have little or no biotechnology."

Unlike many parts of Asia where famine was averted through Green Revolution technologies that could be applied consistently across millions of hectares of land, Sub-Saharan Africa has special challenges—poor soils, unsuitable conditions for irri-

gation, and overall wide variations in growing conditions. Millions of people subsist in fragile areas—on hillsides, forest margins, and in drylands—areas where growing any kind of crop is a challenge.

"We're behind in the development of new technologies that can be applied to the diverse growing conditions of Sub-Saharan Africa," said Per Pinstrup-Andersen, director general of IFPRI. "Much of the agricultural research that has been done in the past was focused on high-potential areas of Asia and is not well-suited to Sub-Saharan Africa. We need more research to help these farmers increase production per unit of land without damaging the environment. We need more drought tolerance in crops grown in these regions, such as cassava, maize, sorghum, and millet, and we need varieties that are more high-yielding and resistant to pests and diseases."

Traditional Plant Breeding Delivers the Goods

Some say that biotechnology is not likely to assist in the process of improving these crops. "In the area of increasing yields, traditional plant breeding has been delivering the goods, not biotechnology," said Margaret Mellon, director of the agriculture and biotechnology project at the Union of Concerned Scientists. "Biotechnology cannot deal with complex traits and multiple gene transfers needed in African crops. All the hype surrounding biotechnology, with the implication that traditional plant breeding should be swept aside, needs to be deflated. Biotechnology has a role, but a minor one."

Agricultural researchers agree that biotechnology is not yet capable of dealing with complex traits. "Many of the concerns in Sub-Saharan Africa, like most of the tropics, are environmental stresses—drought, flooding, and soil stresses," said Roger Beachy, co-director of the International Laboratory for Tropical Agriculture and Biotechnology at the Scripps Research Institute in La Jolla, California. "It has thus far not been demonstrated that genetic engineering can confer resistances to these complex biological traits. But we can certainly expect that in the next 5 or 10 years, genetic engineering will help to arm plants against some of these problems."

However, according to Indra Vasil, plant biologist at the University of Florida and chair of the United Nations Educational, Scientific, and Cultural Organization's (Unesco's) Biotechnology Action Council, biotechnology can be put to great use in traditional plant breeding in Africa right now. "Biotechnology helps to identify new genes, through gene mapping, which makes it easier for plant breeders to select for the right gene combinations." In the case of insects such as aphids, white flies, and caterpillars, biotechnology will also likely be the primary method of control, replacing chemicals and pesticides, according to Beachy. There has been noteworthy

progress in the transfer of genes from the bacterium, *Bacillus thuringiensis* or "Bt," into cotton and corn to combat caterpillars.

But understanding local ecology could potentially be the only environmentally safe way to control the primary culprits that limit production of crops in Sub-Saharan Africa—locusts, grasshoppers, and mealybugs, according to Beachy. He notes that in the past, these voracious insects have been controlled through massive chemical spraying. Recently, the Nigerian-based International Institute of Tropical Agriculture and other organizations have had great success in keeping insects in check through biological control by identifying and using natural predators or using natural fungi or bacteria in sprays.

National Research Programs

The ability to upgrade agriculture in Africa also hinges on the existence of strong national agricultural research programs. "There has been no Green Revolution in Africa," said Vernon Ruttan, regents professor in the Department of Agricultural and Applied Economics at the University of Minnesota. "And the reason is that agricultural technologies that lead to large increases per hectare of land are typically very location-specific. But they can only be adapted to particular locations to the extent that there are strong research programs in those locations."

Furthermore, the national agricultural research programs offer improvements in crop technology to farmers free of charge. "Innovation in Africa will not be accomplished through the private sector," said Klaus Leisinger, executive director of the Ciba-Geigy Foundation for Cooperation with Developing Countries. "It must be accomplished through the public sector, such as through the work of the Consultative Group on International Agricultural Research (CGIAR), combined with national programs and other academic institutions. The reason is that the commercial market in Africa is too small to be developed by the private sector and because, once you create improved crop varieties, they must be within the purchasing power of the small farmer in Africa."

But agricultural research capabilities have deteriorated in Sub-Saharan Africa. "Less is being invested in these programs by African governments than was invested before," said Pinstrup-Andersen. "And overall investment in agricultural research by donors has also declined."

According to Ruttan, the way to build national research programs is by having them develop new technology. "It's a process of learning by doing. You have to have experiment stations and trained scientists, they have to be supported by international funding and by national governments, and they have to be in Africa."

But there is also reason to hope for more productive relationships between the private sector and the developing world agriculture sector. According to Leisinger,

"I would hope that there can be closer collaboration between the private sector and the CGIAR System so that knowledge and patents could be made available in the developing world either on commercial terms through licenses or through 'soft conditions'—lower than market prices or for free."

Dissemination to Farmers

But new technology is only as good as the mechanism of its dissemination to farmers. And, according to African leaders, this link has been quite weak. "In my country, a lot of agricultural research has been undertaken in the last 60 years," said Speciosa Wandera Kazibwe, the vice president of Uganda. "But the bulk of these findings are allowed to gather dust in our archives and research institutions. The challenge is to communicate the findings to the people who need this information—the farmers."

Extension services are also needed to spread the word about better agronomic practices that could help increase crop yields. Fungal and viral plant diseases are particularly devastating in Sub-Saharan Africa, according to Beachy, because of the presence of weeds and the lack of freezing temperatures that help to control them. Weeds are a major reservoir for viruses and diseases. But extension services have not delivered this information to many rural and nomadic farmers, who traditionally plant crops such as cassava on the edge of the forest instead of in plots that are tilled and kept clear of weeds.

Most of Africa's agriculture is rainfed, instead of irrigated, and vulnerable to drought. African leaders cite a need for new, small-scale technologies to irrigate Africa's lands during the dry spells. "We must move to agriculture that relies on water collected during the rainy season," said Vice President Kazibwe. "We must tap underground water and the water in our fresh water lakes and rivers. But we must adopt technologies for storing and using water that are appropriate for our small farms."

Technology Part of a Larger Mosaic

There are many sociopolitical issues that mire new technology once it has been developed. "The developmental impact of recombinant genetics and biotechnology is only as good as the sociopolitical soil in which they are planted," said Leisinger. "Technological innovation is just one stone in a large and complex mosaic."

According to Idachaba, unsound food policies and governmental instability in large part hinder the ability of technology to help the small farmer. Some of the poor policies have included government taxation of agriculture to finance nonagricultural products; lack of government support of agricultural extension services; poor rural

infrastructure, including roads, water supplies, and physical markets in which to buy, sell, and store crops; and unfriendly macroeconomic policy environments, including poor exchange rates that hinder African agricultural exports.

Throughout the 1980s and continuing into this decade some of the poor food policies were reversed, according to Idachaba. "Policy changes are being made that define the proper role of the government in agriculture," he said. "But still, from government to government and from country to country, policy failures persist because their political cost has been too low. We must raise the cost of governmental neglect of African agriculture. Rural people must put political pressure on governments to support improvements in agricultural technologies. In African countries, there are no 'farm lobbies,' but they are urgently needed."

In the drive to develop the best technology to solve Sub-Saharan Africa's mounting food needs, indigenous knowledge should not be forgotten, according to Kazibwe. It was not long ago that Africa was self-sufficient in its own food production. Certainly, some of the lessons of the past can be applied to the future. "Our people who have been engaged in agriculture since the beginning of time have accumulated a lot of knowledge about crops, soils, insects, the weather, and so on," she said. "This body of knowledge should be tapped and related to modern science. If this knowledge sustained our ancestors in the past, it cannot be totally useless today."